Distance education (E-learning) as an effective tool to improve nurses' perception and knowledge of developmental care of preterm infants: A quasi-experimental study

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Abstract

Background: Providing developmental care for preterm infants admitted to the neonatal intensive care unit (NICU) is of special importance. To implement developmental care accurately, NICU nurses must have a proper understanding and sufficient knowledge in this field. This study aimed to investigate the effect of distance education on perception and knowledge of neonatal developmental care in nurses working in neonatal intensive care units.

Methods: This quasi-experimental study was conducted using a pretest-posttest design with two groups. The participants were 60 nurses working in neonatal intensive care units who were selected using convenience sampling. The instruments used to collect the data were the Demographic Information Questionnaire, the Developmental Care Knowledge Scale, and the Developmental Care Perception Scale. The data were collected before and one month after the intervention. The participants in the intervention group received developmental care training using an electronic file uploaded in Navid Learning Management System, while the members of the control group received no intervention. The collected data were analyzed using SPSS V25 software. All statistical tests were performed at the significance level of 0.05 ($P = 0.05$).

Results: The results of paired samples t-test showed there was no statistically significant difference between the mean scores of perception and knowledge of developmental care before and after the intervention in the control group ($p > 0.05$). However, the difference in the pre-intervention and post-intervention scores was statistically significant for the participants in the intervention group ($p < 0.001$). Moreover, the results of the independent samples t-test showed that the mean scores of perception and knowledge of developmental care between the two groups before the intervention was not statistically significant ($p = 0.67$). The results of univariate analysis of covariance also showed that there was a statistically significant difference between the mean score of perception and knowledge of developmental care between the two groups after the intervention ($p = 0.05$).

Conclusion: The results of this study showed that distance education for the developmental care of premature infants plays an effective role in the perception and knowledge of nurses working in the neonatal intensive care unit. Therefore, the development of e-learning packages for developmental care and their availability for nurses can be a step to improve the quality of nursing care for infants admitted to the NICU.

Introduction

Since premature infants are born before the due date, they need special medical care and support. Although advanced medical care is vital to the infant's survival, supportive care also affects brain function and structure of the brain. Besides, the infant's nervous system is developed normally by performing certain types of sensory stimuli appropriate for the infant. The absence of suitable stimuli negatively affects the physiological function and neurobehavioral development of premature infants,

increasing the risk of physical injury, mental retardation, and abnormal development [1]. These infants are sensitive to new conditions after birth, and prematurity exposes them to problems adapting to extraterrestrial life[2]. Performing medical interventions in many situations saves the lives of premature infants, but these interventions are not without complications and may cause acute or chronic problems in premature infants in the long run. Moreover, pain, stress, and separation from parents together with environmental stimuli (ventilators, monitors, incubators, telephone ringtones, and the sound of taps, shelves, and cupboard doors), and multiple cares in the neonatal intensive care unit (NICU) can also negatively affect the infant's health, leading to changes in heart rate and oxygen saturation levels, expanding fluctuations in blood pressure, increasing restlessness in the short run, and delaying the development of the central nervous system and brain in the long run [1, 3]. These conditions are very difficult for the newborn to tolerate and the infant may develop complications such as hypoxemia and unstable blood pressure, apnea, bradycardia, changes in cerebral blood flow, and intraventricular bleeding [3]. To reduce the complications of neonatal admission to the NICU, quality care by the nurse is essential, and effective nursing practices are one of the most important steps for neonatal development and survival [4].

Developmental care refers to the care provided in the neonatal intensive care unit to reduce environmental stress and improve the infant's adaptation to extra uterine life by the care and treatment team with the parents' cooperation and empowerment. Implementation of developmental care improves the condition of each infant and reduces treatment and care costs and is one of the criteria for the implementation of quality care in neonatal intensive care units[5]. This type of care is the implementation of supportive techniques such as reducing environmental stimuli (light, noise, etc.), flutter sucking, music and touch, kangaroo care, and infant pain control techniques [6]. Developmental care aims to reduce the infant's stress, store the infant's energy, enhance the infant's natural growth, and improve quality sleep conditions for the infant. In addition, emotional and behavioral support of the immature infant is very important[7]. Pena (2016) showed that developmental care interventions include support for the infant with the infant's reading behavior, measures to promote the infant's physiological stabilization, and inducing the infants' normal growth and maturity [5]. Razavi Nejad (2017) also emphasized that implementation of new care techniques, including symptom-based care and clustering care as necessary strategies to implement interventions for the normal development of the infant in line with implementing developmental care [8].

Implementing developmental care has both short-term and long-term consequences. Positive outcomes of developmental care include early breastfeeding and weight gain[9], shortening of infants' hospital stay, increasing parental satisfaction, and improving the child's development in later life as one of its long-term consequences [10]. Chou et al. (2015) found that music therapy intervention in the infant environment during development leads to better oxygenation of the infant and possibly increases brain development [3]. Yusuf Nova et al. (2017) also highlighted the effectiveness of a combination of kangaroo care and music interventions in the neonatal intensive care unit and even after discharge [11]. Rahimi et al. (2017) reported that educating nurses and physicians about non-pharmacological control of pain in infants by sucrose and swaddling and limiting painful processes can prevent stress to the infant [6]. Sabaghi et al. (2016) found that the implementation of developmental care has no effect on the duration of

hospitalization of infants under mechanical ventilation [7]. Momeni et al. (2015) showed that the mixed kangaroo care and music therapy had a positive effect on the vital signs of the infant, and also had a significant positive relationship with neonatal behavioral development and their weight gain [3].

Since nursing premature infants admitted to the neonatal intensive care unit requires sensitivity, accuracy, skill, and experience, and given that nurses are the primary caregivers of hospitalized infants, their slightest malpractice can cause irreparable harm to the infant. Therefore, standard care training can improve the quality of nursing services and minimize infants' physical, psychological, and developmental complications.

Currently, it is possible to use distance education techniques to increase learners' knowledge and skills by using appropriate technology and facilitating the learning process at any time and place [12, 13]. To make nurses familiar with the latest developments in providing care to patients, the use of technology in education is necessary [14, 15]. The advantages of e-learning include lower cost, more flexibility, ease of access, inclusiveness, and the ability to self-control in learning and adapting to individual learning goals [10]. Other advantages of e-learning are paying attention to learners' needs, ease of access to various resources, continuous monitoring of academic achievement, and presentation and preparation of various educational models [15]. Increasing nursing knowledge and care skills improve nurses' job satisfaction and the quality of services provided by them [13].

Kadivar et al. (2017) stated that e-learning programs are effective in increasing the motivation of health care staff in providing neonatal care [13].

Issues such as understanding and awareness of the type of care are likely to affect its implementation. Education is one of the ways that can affect nurses' awareness. Since very limited studies have addressed distance education for developmental care in Iran, this study aims to examine the effect of a developmental-care-based distance education program on the perception and knowledge of nurses working in the neonatal intensive care units of Afzalipour Hospital in Kerman in 2020.

Methods

Research design and setting

This interventional (quasi-experimental) study with a pretest-posttest design with two groups was performed on nurses working in the neonatal intensive care units of Afzalipour Hospital in Kerman, Iran, from January to May 2020. Afzalipour Hospital in Kerman has two neonatal intensive care units with more than 70 beds (each ward contains 35 beds) that provide services to infants at level 3A. This hospital is the first and largest educational and medical center in southeast Iran and one of the advanced centers for providing medical services and cares to infants in the south and east of Iran.

Sampling method

A total of 70 nurses in the neonatal intensive care unit were enrolled in the study using the census method. Ten nurses who did not meet the inclusion criteria were excluded from the study and thus the final sample included 60 nurses who participated in all stages of the study. The inclusion criteria were having at least a degree in nursing and working at least one month in the neonatal intensive care unit. The exclusion criteria were not completing the questionnaire and not completing the training process in Navid Learning Management System.

Intervention group procedure

After obtaining the necessary permits and providing some information about the objectives of the study, written consent was received from the nurses. Then, the nurses who met the inclusion criteria were enrolled in the study using the census method. Before conducting the intervention, a meeting was held for the participants in the two groups to make them familiar with the Navid system. After making arrangements with the system administrator, each nurse was given a username and password. Then, the nurses in the two groups completed the three questions. The nurses in the intervention group received e-learning content containing instructions on neonatal developmental care, which was uploaded to the Navid System (special software for university education). The training package covered all topics on neonatal developmental care, which was extracted from the latest neonatal intensive care nursing textbooks (table 1). To enhance the efficacy of the learners' learning, electronic content was supplemented with instructional videos, slides, photos, and short passages with audio instructions. The training content was confirmed by professors at the Department of Pediatrics of Kerman University of Medical Sciences. Navid System is the software system of Iran's Ministry of Health and Medical Education and provides e-learning facilities including all services related to education, evaluation, interaction, planning, and educational management.

Table 1: The contents of the training program

Session	Description
1	<p>Defining developmental care and its importance</p> <p>Improving the physical space in the developmental care program including facilities, access routes, corridors, and entrances of the neonatal intensive care unit, specialized hospitalization, and neonatal care space, essential support spaces in the neonatal intensive care unit</p> <p>The effect of excessive sensory stimulation in infants: The importance of adjusting the lighting in the NICU to protect the premature infants' vision, considerations related to the care of the preterm infant hearing, controlling the noise, the importance of developing the baby's olfactory and taste senses, the importance of infant tactile sensation, and tips about infant massaging</p>
2	<p>Physical-behavioral reactions of premature infants, including behavioral evaluation and control, completing the objective observation sheet, forms for observing and recording infant behavior, identifying infant behaviors, autonomic nervous system behaviors, skin color, movements due to immaturity of the autonomic nervous system, autonomic and visceral systems, neonatal movements, specific movements of limbs, behaviors related to attention and interaction, behaviors showing self-regulatory balance, behaviors indicating neonatal stress</p>
3	<p>Characteristics of premature infant sleep-wake-up patterns, including the importance of sleep-wake in preterm infants, diagnosis of premature infant sleep-wake states, types of premature infant sleep-wake states, benefits of sleep in infants, complications of sleep deprivation in infants, factors disrupting premature infant sleep-state, the infant sleep space in NICU, developmental care to support the sleep of premature infants</p>
4	<p>Assessing the status of the infant including the importance of supporting the infant's body and positioning the premature infant, developmental complications due to lack of support and positioning of the premature infant in the NICU, developmental benefits of positioning the preterm infant admitted to the NICU, general principles of premature neonatal positioning in the NICU, the infant's position during kangaroo care, the principles of lifting and moving the infant</p> <p>NIDCAP program: clustering and symptom-based care</p> <p>Management and control of pain in premature infants: infant response to pain, non-pharmacological care, prescribing medication for pain control, infant pain management protocol (care before the onset of painful procedures, care during painful procedures, care about painful procedures)</p>
5	<p>Premature infant nutrition: oral feeding with developmental care approach, developmental care in infant feeding with a gastric tube, infant oral feeding, successful oral sucking, development of swallowing process, significant cases for diagnosing the time of oral feeding, environmental factors affecting infant oral feeding and its continuity, oral feeding patterns based on infant demand, the importance of infant hospitalization space in supporting breastfeeding, non-oral sucking</p>
6	<p>Family-centered care and its effects on premature infants: significant ethical issues regarding the infant and parents, success in family-centered care, family-centered care in lien with the mission of the neonatal intensive care unit, guide to social interactions with the family care group, parental education, parental support resources, mother's residence, and infant visit rules, facilities needed for mothers' residence</p>

The e-learning package used in this study contained 6 separate sections. The participants had to review all content in each section so that they could go to the next step. Each participant could watch the

instructional materials as many times as needed. The participants could access the materials for about two weeks. The intervention was completed in 6 days. During the study, the researcher could have full control over the number of times the training file was viewed by the participants. Moreover, all the participants' questions were recorded by them in the system and answered by the researcher. The system provided the possibility of two-way interaction via texting and audio and video calls between the researcher and the participants.

The participants could access training files 24 hours a day. Given the nurses' multiple and busy working shifts, they could view the training files at any time. One month after the completion of the intervention, the participants in the intervention group again completed the questionnaires in the Navid system. To prevent the exchange of information between the members of the intervention and control groups, the participants in the intervention group were asked not to share the information with the participants in the control group until the end of the study.

Control group procedure

Before attending the NICU, the nurses in the control group had to complete a one-month clinical skills training course. The nurses received this type of training by working with an experienced nurse with a focus on acquiring clinical nursing skills in neonatal care. These nurses did not receive any organized training in developmental care from the hospital. They completed the questionnaires before and one month after the intervention in the Navid system. Upon the completion of the intervention, the content of the e-learning program was provided to the nurses in the control group.

Instruments

The data in this study were collected using three instruments including the Demographic Information Questionnaire, the Developmental Care Knowledge Scale, and the Developmental Care Perception Scale.

The Demographic Information Questionnaire: This questionnaire assessed the participants' gender, age, marital status, education, work experience in the neonatal intensive care unit, work shifts, position, and type of employment [16].

The Developmental Care Perception Scale: This tool was developed by Baghlani et al. (2019). It contains 20 items designed on a 5-point Likert scale ranging from 0 to 5. The total score on the scale ranges from 0 to 100 and each item is scored separately. The content validity of the scale was also assessed and confirmed by the authors and its reliability was reported 0.92 using Cronbach's alpha coefficient [16].

The Developmental Care Knowledge Scale: The scale was developed by Baghlani et al. (2019). It contains 20 four-choice items, each having a correct answer, which is scored 1, and the wrong answers are scored 0. The total score on the scale ranges from 0 to 100. The validity and reliability of the scale were assessed and its validity was confirmed. Besides, its reliability was estimated using the test-retest

method and Cronbach's alpha coefficient and a coefficient of higher than 0.70 indicated the acceptable reliability of the scale [16].

Data analysis

The collected data were analyzed with SPSS V25 software using descriptive and inferential statistics. To describe the participants' demographic characteristics and determine their perception and knowledge of developmental care, measures of central tendency and dispersion (frequency, percentage, mean, and standard deviation) were used. Moreover, the paired samples t-test was run to compare the developmental care perception and knowledge scores for the participants in each group before and after the intervention. In addition, independent samples t-test and univariate analysis of covariance were used to compare the developmental care perception and knowledge scores between the two groups before and after the intervention.

Results

The participants in this study were two groups of female nurses ($n = 60$) working in neonatal intensive care units. Most of the nurses in the intervention (56.7%) and control group (73.3%) were 20–30 years old. Moreover, there were no statistically significant differences between the two groups in terms of demographic characteristics such as age, marital status, having a premature infant, education, having a nursing degree, employment, working shift, attendance in training courses, and work experience. In other words, the two groups were homogenous in terms of demographic variables ($p < 0.05$) (Table 2).

Table 2

The participants' demographic characteristics of nurses in the intervention and control groups

Variable	Categories	Intervention (n = 30)		Control (n = 30)		Results
		Number	%	Number	%	
Age (years)*	20–30	17	56.7	22	73.3	$\chi^2(2) = 5.496$ P = 0.064
	31–40	4	13.3	6	20	
	41–50	9	30	2	6.7	
Marital status*	Single	12	40	11	36.7	$\chi^2(1) = 0.071$ P = 0.791
	Married	18	60	19	63.3	
Premature child**	Yes	1	3.3	0	0	1P =
	No	29	96.7	30	100	
Education*	Bachelor's degree	25	83.3	24	80	$\chi^2(1) = 0.111$ P = 0.739
	Master's degree	5	16.7	6	20	
Field of study*	Pediatrics	5	16.7	7	23.3	$\chi^2(1) = 0.417$ P = 0.519
	Nursing	25	83.3	23	76.8	
Employment*	Official	11	36.7	10	33.3	$\chi^2(2) = 0.698$ P = 0.705
	Contractual	9	30	12	40	
	Plan-based	10	33.3	8	26.7	
Work shift**	Fixed	1	3.3	2	6.7	1P =
	Rotating	29	96.7	28	93.3	
Participation in training courses	Yes	5	16.7	10	33.3	$\chi^2(1) = 2.222$ P = 0.136
	No	25	83.3	20	66.7	
Service records in NICU (year)*	1>	10	33.3	5	16.7	$\chi^2(2) = 4.602$ P = 0.100
	1–5	9	30	17	56.7	
	< 5	11	36.7	8	26.7	
*Chi-square test and **Fisher's exact test						

Before the intervention, there were no significant differences in the mean scores of neonatal developmental care perception between the intervention group (84.53 ± 9.48) and the control group (83.40 ± 11.36) as indicated by the independent samples t-test ($P = 0.67$). However, the results of the univariate analysis of covariance (ANCOVA) showed significant differences in the mean scores of neonatal developmental care perception between the intervention group (94.70 ± 6.89) and the control group (83.16 ± 13.73) after the intervention ($P < 0.001$), indicating a significant increase in the mean score of neonatal developmental care perception in the intervention group compared to the control group (Table3).

Table 3
comparing the mean scores for participants' perception of neonatal developmental care inter and between two groups

Developmental care perception	group	Pre-intervention**	Post-intervention*	Mean difference	Intragroup comparison***
Neonatal	Intervention	51.73 ± 5.87	56.80 ± 4.14	-5.066	t (29) = -4.630 P < 0.001
	Control	50.43 ± 7.22	50.40 ± 8.52	0.033	t (29) = 0.028 P = 0.977
	Mean difference	1.30	6.40	-	-
	Intergroup statistics	t(58) = 0.765 P = 0.447	F(1,57) = 15.233 P < 0.001 $\eta^2 = 0.211$	-	-
Nursing	Intervention	32.80 ± 5.01	37.90 ± 3.33	-5.100	t (29) = -4.833 P < 0.001
	Control	32.96 ± 5.54	32.76 ± 5.55	0.200	t (29) = 0.262 P < 0.796
	Mean difference	-1.166	5.14	-	
	Intergroup statistics	t(58) = -0.135 P = 0.893	F(1,57) = 23.054 P < 0.001 $\eta^2 = 0.288$		
Developmental care perception	Intervention	84.53 ± 9.48	37.90 ± 3.33	-10.66	t (29) = -5.381 P < 0.001
	Control	83.40 ± 11.36	32.76 ± 5.55	0.233	t (29) = 0.123 P < 0.903
	Mean difference	1.133	5.14	-	
*Univariate analysis of covariance, ** Independent samples t, ***Paired samples t-test, η^2 effect size					

Developmental care perception	group	Pre-intervention**	Post-intervention*	Mean difference	Intragroup comparison***
	Intergroup comparison	t(58) = 0.419 P = 0.677	F(1,57) = 23.054 P < 0.001 $\eta^2 = 0.288$		
*Univariate analysis of covariance, ** Independent samples t, ***Paired samples t-test, η^2 effect size					

The results also suggested that there were significant differences in the mean scores of neonatal developmental care knowledge between the intervention group (77.16 ± 17.20) and the control group (62.66 ± 18.08) before the intervention as indicated by the independent samples t-test ($P < 0.001$). Furthermore, the results of the univariate analysis of covariance (ANCOVA) showed significant differences in the mean scores of neonatal developmental care knowledge between the intervention group (90.33 ± 13.82) and the control group (53.66 ± 26.55) after the intervention ($P < 0.001$), indicating a significant increase in the mean score of neonatal developmental care knowledge in the intervention group compared to the control group (Table4).

Table 4
comparing the mean scores for participants' knowledge of neonatal developmental care inter and between two groups

Group	Pre-intervention**	Post-intervention*	Mean difference	Intragroup comparison***
Intervention	77.16 ± 17.20	90.33 ± 13.82	-13.16	t (29) = -4.111 P < 0.001
Control	52.66 ± 18.08	53.66 ± 26.55	-1	t (29) = -0.379 P = 0.702
Mean difference	24.50	36.67		
Intergroup comparison	t(58) = 5.376 P = 0.001	F(1,57) = 11.478 P < 0.001 $\eta^2 = 0.168$		
*Univariate analysis of covariance, ** Independent samples t, ***Paired samples t-test, η^2 effect size				

Discussion

The present study investigated the effect of distance education on perception and knowledge of neonatal developmental care in nurses working in neonatal intensive care units. The results indicated that before the intervention, there was no statistically significant difference between the intervention and control groups in terms of nurses' perceptions and knowledge of developmental care. However, the mean score of perception and knowledge of developmental care of premature infants in the intervention group was significantly higher than the control group, indicating e-learning positively affected the score of the nurses' perception and awareness after the intervention. A review of the literature showed that there was no study addressing the effect of e-learning for the developmental care of premature infants on the perception of nurses working in neonatal intensive care units. Thus, this section reviews studies that had a greater similarity with the present study. Khatiban et al. (2014) examined the effect of education on the perception of ICU nurses about barriers to compliance with infection control standards. The results indicated that education has a positive effect on the perception of intensive care nurses about the barriers to compliance with general infection control standards [17]. This study was similar to the current study in terms of the impact of education. However, the nurses in the present study received offline training while Khatiban et al. (2014) used conventional educational methods to train the nurses. In another study, Solhaug (2010) measured the effect of the use of developmental care on nurses' perceptions in an intensive care unit and concluded that nurses' perceptions increased after the implementation of the developmental care program [10]. This study measured the impact of developmental care on nurses' understanding but it differed from the current study in that the intervention was not conducted in the form of a training program.

A descriptive study by Mosqueda-Pena (2016) showed the positive effect of developmental care training on the knowledge and satisfaction of 566 health care professionals in neonatal intensive care units [5]. This study was similar to the present study in terms of developmental care training but differed from the present study in terms of the type of training course implemented. The authors used traditional training methods and workshops to provide training to the participants. Given the nurses' high workload and the fact that they have to work in different shifts, the use of distance education with features such as flexible instructional hours can improve nurses' knowledge. Thus, e-learning according to its flexibility in presenting training content is very practical for meeting nurses' educational needs.

Zamani et al. (2019) examined the effect of web-based education on NICU nurses' knowledge, attitude, and care performance and showed that the average knowledge score in the web-based education group increased significantly compared to the control group. However, there was no significant difference between the two groups in terms of mean scores of attitude and care performance [18]. In this study, the educational content was instructed in the form of general care in the neonatal intensive care unit. However, the training content in the present study focused on developmental care for premature infants. Nevertheless, both studies used e-learning techniques. Web-based education seems to not only update nurses' care information but also teach them how to use new technologies. Furthermore, e-learning is very suitable for people who have developed self-discipline, and nurses can participate in such training courses by managing their time based on their working shifts in the hospital. During the current study, none of the participants were excluded due to missing the training course.

Deloian (2015) showed that web-based training significantly increased NICU nurses' knowledge of breastfeeding after the intervention [19]. This finding was similar to the present study in terms of the effectiveness of e-learning courses as the training content is provided based on learners' needs. Similarly, the provision of e-learning content on developmental care was one of the nurses' educational needs in the present study.

Agrawal et al. (2016) examined the effectiveness of virtual classroom training in improving the knowledge and key maternal neonatal health skills of general midwifery students and found that virtual classroom training was effective in improving students' knowledge and key skills [20]. In this study, both the knowledge and skills of students were improved via virtual education, partly confirming the results of the present study. Given that e-learning packages are prepared in terms of content perfectly tailored to the educational objectives, they can be used for higher-level learning such as improving learners' awareness and skills. Accordingly, this study showed that in addition to nurses' knowledge, their understanding of developmental care was improved. Hasanpour et al. (2017) studied the effect of a neonatal sleep care training program on nurses' knowledge and practice in neonatal intensive care units and showed that training increased nurses' knowledge, but there was no significant change in their performance [21]. Perhaps due to the low number of training sessions. Therefore, it is essential to organize and implement long-term training programs. The training content in Hasanpour et al.'s (2017) study focused on infants' sleep and wakefulness, which is one of the goals of developmental care. Similarly, the present study addressed infants' sleep and wakefulness as part of the educational content of developmental care. In addition, in the present study, there was no limit to the number of views of training content that was prepared in 6 separate 120-minute episodes. Besides, since the training files were accessible 24 hours per day, the nurses were able to watch and use the files whenever they wished. Perhaps one of the reasons for the effectiveness of e-learning was this feature.

Given the importance of developmental care in limiting complications in premature infants, the implementation of such training is also useful to improve nurses' care skills since raising nurses' awareness and knowledge also leads to increasing the quality of care performance. In their review study, Als et al. (2011) highlighted the importance of educating nurses in the newborn individualized developmental care and assessment program (NIDCAP) with kangaroo mother care (KMC) because the implementation of these training programs not only increases nurses' knowledge in a given field but also improves their awareness of the consequences of their implementation, e.g. their effect on the development of infants' brain function and central nervous system [22].

Offering developmental care by nurses in the neonatal intensive care unit leads to quality care, and infants are discharged with minimal complications. Thus, nurses must have sufficient knowledge and understanding of the type of care to be able to demonstrate proper care performance. On the other hand, the use of distance education and e-learning techniques according to nurses' working conditions is one of the most effective strategies for empowering nurses.

Limitations

Since the nurses could forget to watch the uploaded files, a reminder text message was sent to them every day. Moreover, the researcher could view the learners' profiles in the Navid system, and the researcher could monitor the time and number of times each file was viewed by the nurses, thus, it greatly helped to overcome this limitation. Another limitation of this study was that the participants were selected from a single medical center. Thus, future studies can be performed on larger populations from multiple centers.

Conclusion

The present study showed that distance education on how to implement developmental care for premature infants has an effective role in improving the understanding and knowledge of nurses working in neonatal intensive care units. Since nurses play a key role in providing care services, it is essential to pay attention to promoting their knowledge and awareness. Distance education is recommended as a flexible, accessible, and low-cost method that allows access to multimedia and engaging educational content anywhere and anytime to train nurses in neonatal intensive care units and other wards. Thus, officials and managers of hospitals and medical centers are recommended to make necessary planning for the implementation of distance education for nurses working in neonatal intensive care units.

Declarations

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Author contribution

This manuscript is the consequence of the collaboration of all the authors. Author MN designed the study, SJ and MF wrote the study proposal, SJ conducted data collection, and analyzed the data. The author BB and ZJ analyzed the data, and the Author RM and KR wrote the final draft of the manuscript, prepared tables, and MN submitted the document to the journal. Also, all authors have read and approved the manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

Ethics approval and consent to participate

The approval for this study was obtained from Ethics Committee of Kerman University of Medical Sciences (IR.KMU.REC.1398.557). Written informed consent was obtained from each participant. This study was performed on nurses working in NICU from August 2019 till July 2020. The participants were assured that their information would only be used for analysis in this study. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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